

## SORDITO

### System for Route Optimization in Dynamic Transport Environment (October 2014 – February 2016)

The goal of the SORDITO Project is to develop an algorithm that computes in advance the best traffic route for the purposes of private users and business application regarding traffic congestion that can be predicted. The Time Dependent Vehicle Routing Problem (TDVRP) algorithm is used to optimize the time constrained transport in order to reduce time and overall costs, while for predicting the vehicle speed on specific road segment the speed profiles were used. The project was co-funded by the European Regional Development Fund with the total value of HRK 3,475,670.37. Eighteen researchers from the Faculty of Transport and Traffic Sciences, University of Zagreb and Mireo Inc. participated in the project. The Project included four newly employed researchers. The Steering Committee consisted of Prof. Hrvoje Gold, Ph.D., Prof. Sadko Mandžuka, Ph.D., Asst. Prof. Edouard Ivanjko, Ph.D.E.E., Ivica Siladić, Ph.D. and the Project leader Assoc. Prof. Tonči Carić, Ph.D. Intermediary bodies that managed the Project were the Ministry of Science, Education and Sports and the Central Finance and Contracting Agency. The general objectives of the Project call were capacity building for technology transfer, aligning the research to the needs of economy, investments in research equipment and supporting the commercialization of the Project results. The main goal was the development of an optimization algorithm for Vehicle Routing Problem in dynamic traffic and transport environment, an algorithm for speed profile distribution and an algorithm for navigation between two points in the network were developed. In the end the results were verified by tests in real traffic environment. In order to transfer the project achievements to the public, the dissemination activities played an important role. For this purpose three conferences and two workshops were held by the Faculty of Transport and Traffic Sciences, University of Zagreb. At the conferences the Project members presented the results while at the workshops international experts transferred knowledge to the Project members.

The base of the Project was predicting the travel time between any two points on the road network. For that purpose the speed profiles that represent the daily speed change on the road segment were used. By knowing the speed at some specific time period and the length of the road segment, the time to traverse the road segment can be predicted. This way a routes travel time is obtained by summing travel times per

road segments on a route. In order to compute an average speed per time intervals the data mining approach was performed on GPS Big Data. GPS Big Data consist of over 6 billion GPS records that were collected during the period from 2009 to 2014 by the Project partner Mireo Inc. As speed profiles are actually spatial and temporal distribution of aggregated speed data, time, duration, location and intensity of traffic congestions can be predicted.

Currently available industry navigation uses static information about the traffic conditions (average speed or speed limit on the road) for navigating between the two points on the road network. What the Project developed went one step further and it was to include the information about traffic congestions in route navigation, in the form of speed profiles. In order to find the route with the shortest travel time the Dijkstra's algorithm was modified to use the developed speed profiles (Time Dependent Dijkstra's Algorithm).

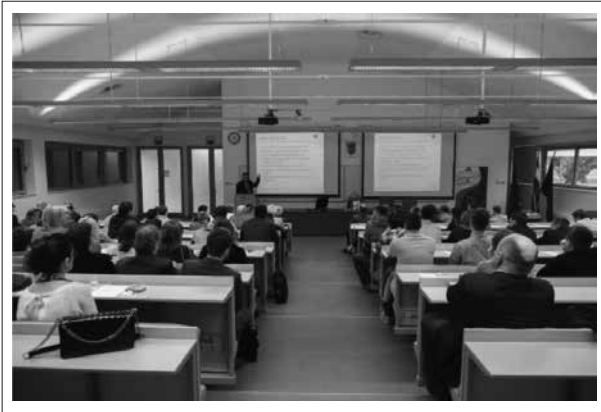


*Installing the radar to verify speed profiles*

Furthermore, the project developed an optimization algorithm for routing a fleet of vehicles using the developed time-dependent shortest path algorithm. The algorithm is typically used in logistics for routing the delivery vehicles. The idea was to determine the shortest travel time for each of the vehicles in the fleet, while taking into account the constraints such as: capacity of the vehicle, working hours, delivery hours, etc. In this way it is possible to achieve significant reduction in time, fuel and number of vehicles.

As part of the Project two web applications were developed. One for the presentation of the shortest path between two points on the road network. And the second, for the presentation of the developed speed profiles. Also, an application for routing the fleet of vehicles was developed.

The testing done in real traffic environment showed that the error of the developed TDVRP algorithm and route travel time prediction are under 20% compared to the measured travel time.



*The SORDITO final Conference held on 15th February 2016*

Ten years of collaborative work on optimization problems with industrial partner Mireo Inc. and funding from the European Regional Development Fund resulted in SORDITO Project application. Collaboration between the industry and studies led to a successful completion of the Project which includes patent and articles application, conferences, implementation of time-dependent fleet and route navigation and all of the other Project activities.

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